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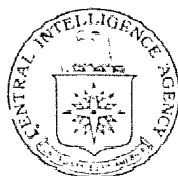
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January 1964

PHOTOGRAPHIC INTERPRETATION REPORT

# RADIO RELAY AND BROADCAST STATIONS AT LAPICHI, RAZDOLNOYE, AND ULYANOVKA, USSR

DECLASS REVIEW BY NIMA/DOD



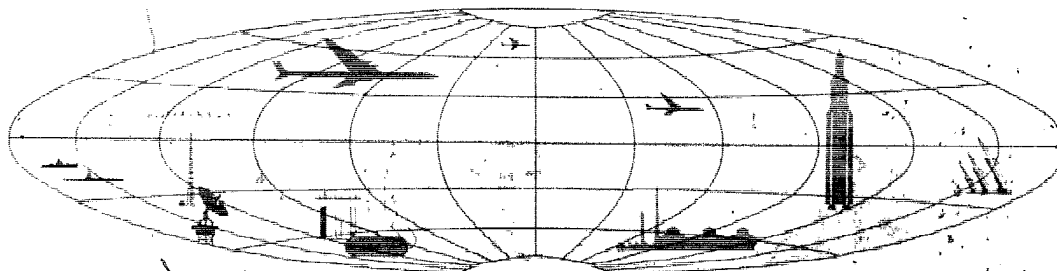
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PHOTOGRAPHIC INTERPRETATION REPORT

RADIO RELAY AND BROADCAST STATIONS  
AT LAPICHI, RAZDOLNOYE,  
AND ULYANOVKA, USSR

NPIC/R-60/64  
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PREFACE

This report has been prepared in answer to requirement DIA-API-63-87 which requested information on an electronics site at Lapichi where a linear array had been observed. Two additional sites having similar arrays are also covered, and some background information based on a similar experimental array in the US is provided in an Appendix.

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## INTRODUCTION

Linear arrays of the Lapichi type represent an apparently successful Soviet attempt to improve high-frequency propagation by reducing the effects of multipath and interference.

Although such an array was first noted at Lapichi on photography of [REDACTED] a review of earlier photography indicates that two similar arrays had been completed near Razdolnoye as

early as [REDACTED] The apparent success of the antenna system is indicated by the fact that additional similar arrays were constructed at Lapichi and Ulyanovka. These latter arrays are in secured areas in which probable medium-wave broadcast radiators were also under construction in [REDACTED]

25X1D

25X1D

## CONSTRUCTION CHRONOLOGY

Linear arrays have been erected at antenna farms near Lapichi, Razdolnoye, and Ulyanovka, USSR (Figure 8). At Lapichi and Ulyanovka, typical medium-wave vertical radiators were also under construction in [REDACTED] A brief chronology of significant construction at the three antenna farms precedes more detailed physical descriptions.

Lapichi Antenna Farm was first observed on [REDACTED] photography of [REDACTED] at which time only the linear array was apparent. Pole foundations were evident; however, the poles themselves were not discernible. Control buildings were complete, but there was construction activity in adjacent areas.

The first evidence of two probable vertical radiators was revealed on [REDACTED] photography of [REDACTED] when one cleared circular area and one cleared semicircular area were observed. By [REDACTED] all construction appeared nearing completion.

Razdolnoye Antenna Farm was first observed on oblique aerial photography of [REDACTED] at which time two linear arrays appeared complete and operational. No significant change has taken place since.

Ulyanovka Antenna Farm was first observed on [REDACTED] photography of [REDACTED] There were completed curtain arrays, but the linear array was in an early stage of construction. First evidence of construction of vertical radiators appeared on photography of [REDACTED]

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### LAPICHI ANTENNA FARM

Lapichi Antenna Farm is located at 53-25N 28-31E, 2 nautical miles (nm) northeast of Lapichi and 45 nm southeast of Minsk. It is located in a low marsh area which is ideal for conductivity, and it contains a linear array and two probable vertical radiators. The farm is surrounded by a security fence.

The linear array is in a cleared area, measures about 6,775 feet, and is oriented on an azimuth of 60/240 degrees (Figure 8). There are 26 pole-supported in-line elements spaced [REDACTED] feet apart, each pole being approximately 35 feet high. Located to the south and near the eastern end of the array is a 110- by 55-foot central control building, and two cooling ponds are under construction between the building and the array. A second possible control building measuring 140 by 20 feet is situated at the terminus of a

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service road to the southeast of the first control building. An electrical power substation is located along the main service road, within the secured area. The presence of the cooling ponds and the electrical power substation indicates that the farm has a transmitting capability (Figures 1 and 2).

Two probable vertical radiator positions are

located southeast of the linear array. If the vertical radiators could be identified, they would occupy the centers of two circular ground systems, each 1,575 feet in diameter. Radial cable scars are present at intervals from the centers of these systems. Centers of the circles are 5,315 feet apart and a line connecting them would be oriented on an azimuth of 20/200 degrees. Each

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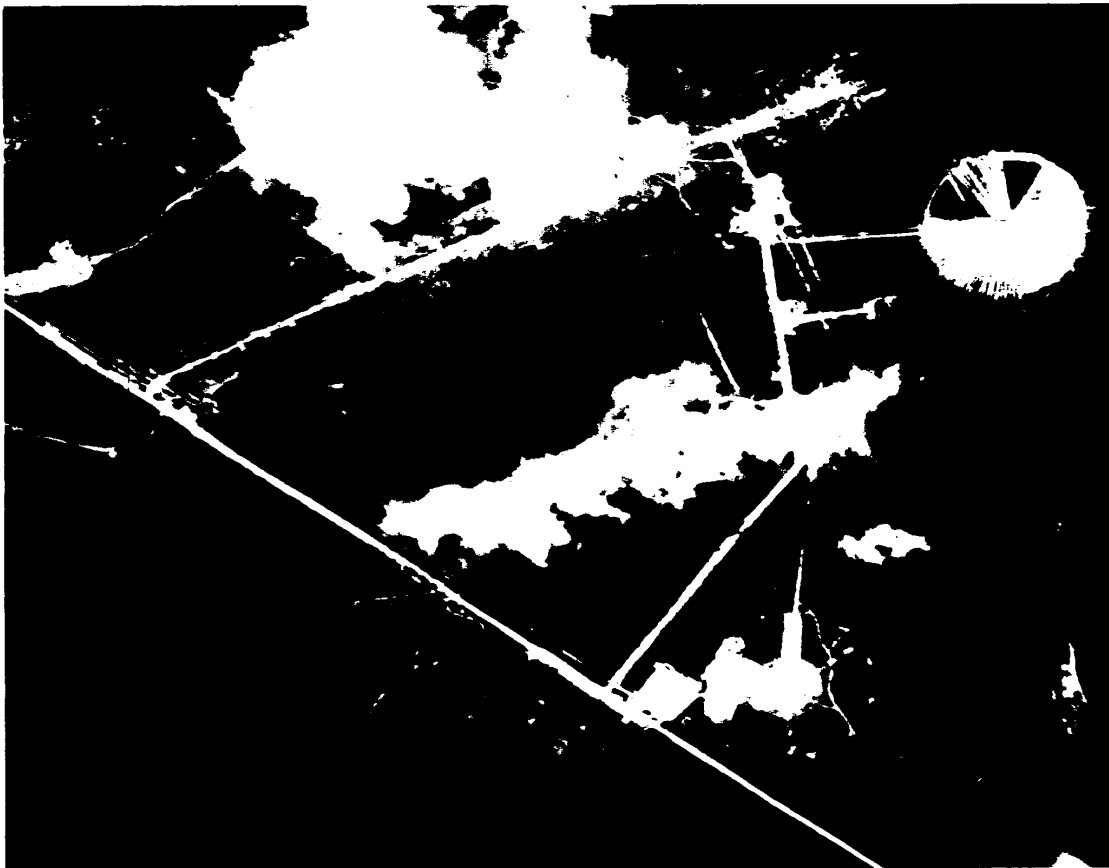


FIGURE 1. LAPICHI ANTENNA FARM.

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circle has three guy legs 120° apart, and four guy anchor positions are spaced at 165-foot intervals out these legs. Also visible on the southern circle are three concentric circular scars approximately 80 feet apart (Figure 3). Both ground systems have ground scars every 30° arc around their perimeters.

Support buildings are not present within the secured area; however, two nearby barracks

areas could supply adequate support. One is located 1.5 nm northwest and the other 2 nm southwest of the central control building.

#### RAZDOLNOYE ANTENNA FARM

Razdolnoye Antenna Farm is located at 43-32N 131-56E, 1.5 nm east of Razdolnoye and 25 nm north of Vladivostok. The installation is on the top of a hill, at an average site elevation of

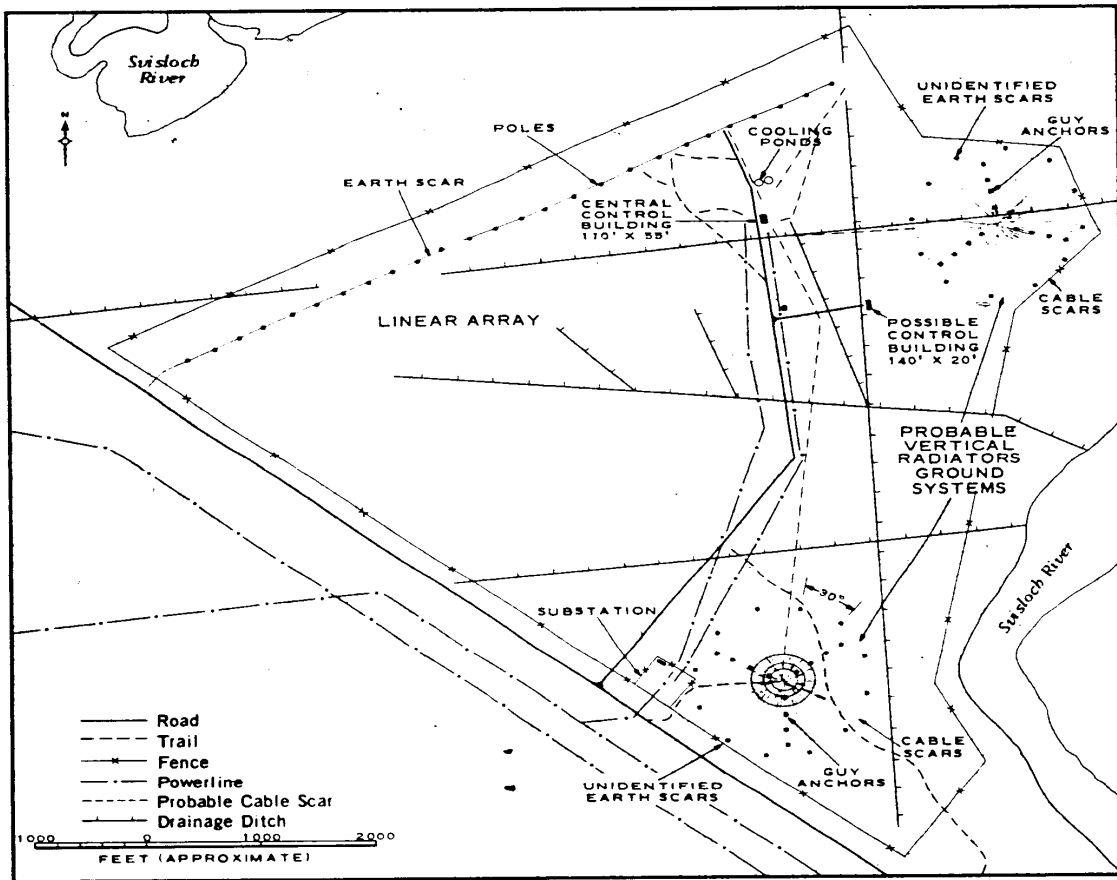


FIGURE 2. LAPICHI ANTENNA FARM.

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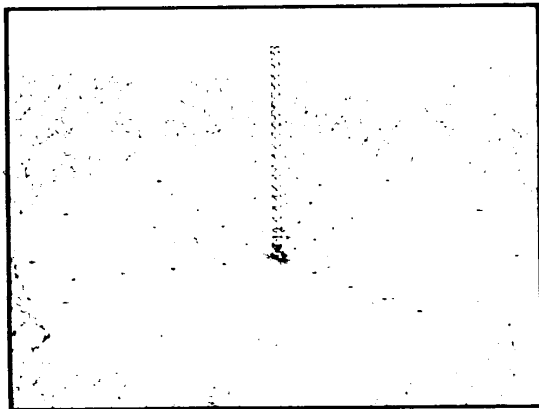


FIGURE 3. LAPICHI GROUND SYSTEM WITH TYPICAL VERTICAL RADIATOR.

600 feet. Care has been taken to position the elements of each array at a common elevation. The site is road served, and no security fences are apparent (Figures 4 and 5).

This installation has two linear arrays (Figure 8). The longer one, oriented on an azimuth of [redacted] is 6,545 feet long and is composed of 25 in-line pole-supported elements. The poles are about 70 feet high and spaced 280 feet apart, except that the pole at the southwest end is only 160 feet from the adjacent pole.

The shorter array is 3,570 feet long and has 15 pole-supported elements in a line oriented on an azimuth of [redacted] (Figure 8). The poles are about 255 feet apart and 70 feet high.

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FIGURE 4. RAZDOLNOYE ANTENNA FARM, [redacted]

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The control center is located between the two arrays and contains two control buildings, four cooling ponds, and several buildings and unidentified structures. The control building near the 25-element array is approximately 135 by 100 feet, and the other control building is approximately 130 by 80 feet. The cooling ponds are all about 40 feet, inside diameter.

An electrical power substation adjacent to the western cooling ponds is served by a powerline from the north. A second possible substation is probably fed by a second powerline from the northeast. About nine probable shop and maintenance buildings along the roads leading to Razdolnoye could provide limited support.

#### ULYANOVKA ANTENNA FARM

Ulyanovka Antenna Farm is located 59-39N 30-41E, 2 nm northwest of Ulyanovka and 20 nm southeast of Leningrad on flat marshy terrain. The installation is security fenced and contains three antenna systems: one linear array; one probable vertical radiator system; and a serpentine of curtain arrays (Figures 6 and 7). Curtain arrays have been adequately described previously 1/ and will not be treated in this report.

The linear array is 6,750 feet long and consists of 26 pole-supported in-line elements oriented on an azimuth of 80/260 degrees (Figure 8). The supporting poles are   apart and approximately 135 feet high. A control building, 160 by 125 feet, is located north of the array with

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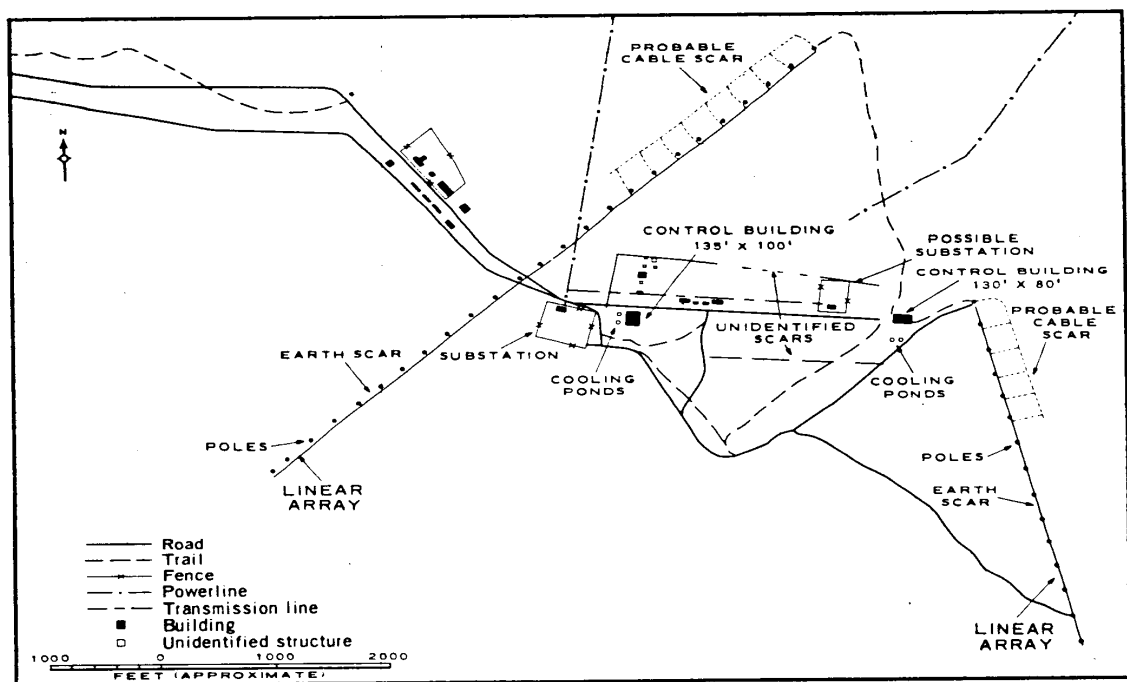


FIGURE 5. RAZDOLNOYE ANTENNA FARM.

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two cooling ponds, each approximately 40 feet in diameter, adjacent on the east.

Two probable vertical radiator positions north of the linear array appear to be in early stages of construction. The guy legs can be identified and appear identical to those at Lapichi. Centers of the two positions are about 4,600 feet apart, and a line connecting them would be oriented on an azimuth of 65/245 degrees. Cable scars from the probable vertical radiator system to the control building which serves the linear

array indicate that the two systems will utilize the same facilities.

Numerous cleared areas within the secured limits of the installation indicate possible additional antenna systems, but none can be identified on existing photography.

At the northern end of the installation, complete housing and support facilities are evident and include a probable electrical power substation which is served by the main powerline west of the installation.

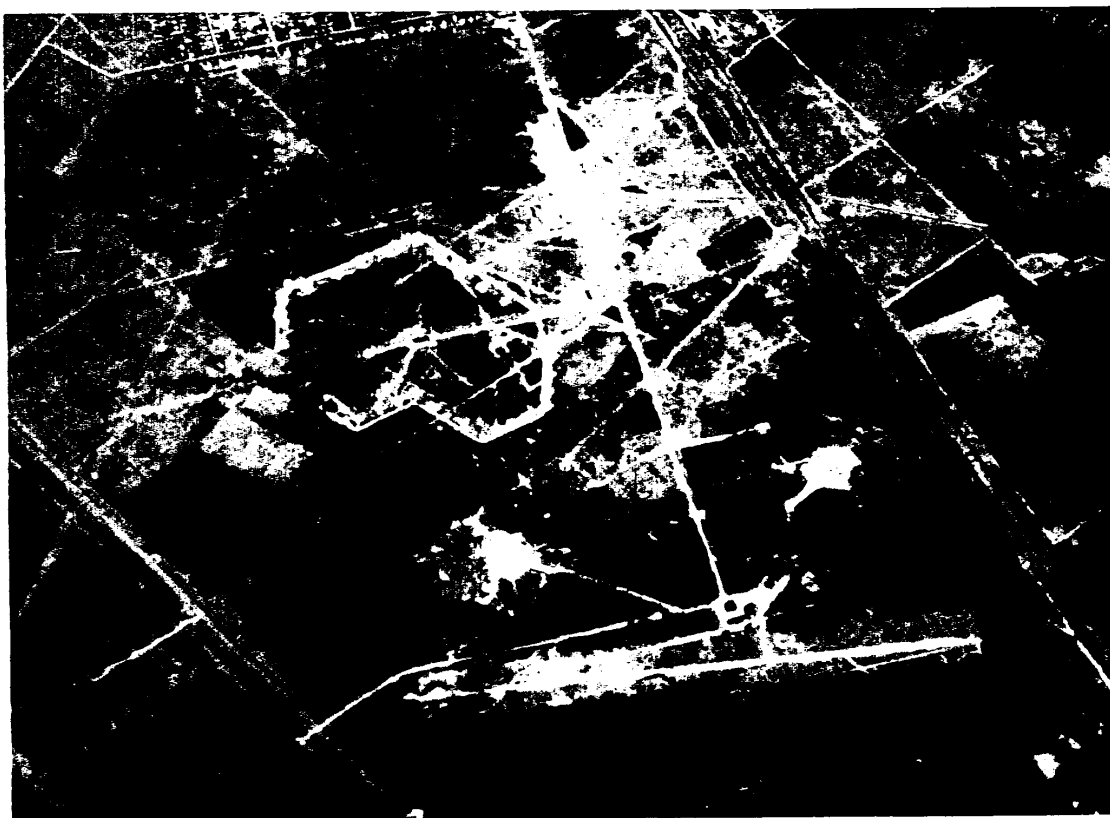


FIGURE 6. ULYANOVKA ANTENNA FARM,  25X1D

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# CONCLUSIONS

Some estimates have been made of the antenna design frequencies of the systems at the antenna farms. Although it cannot be determined from available photography that the vertical radiators have been erected at Lapichi and Ulyanovka, the ground systems are apparent. At Lapichi there are both radial cable scars and guy anchors designed to stabilize vertical antennas, and at Ulyanovka, where the system is in an

earlier stage of construction, the guy anchors can be identified.

Standardization in ground systems indicates that the optimum radius would be approximately one-half wave length. For the Lapichi ground systems, which are 1,575 feet in diameter, the frequency would be approximately 620 kc. The optimum electrical height of a medium-frequency radiator is about 10° more than one-half

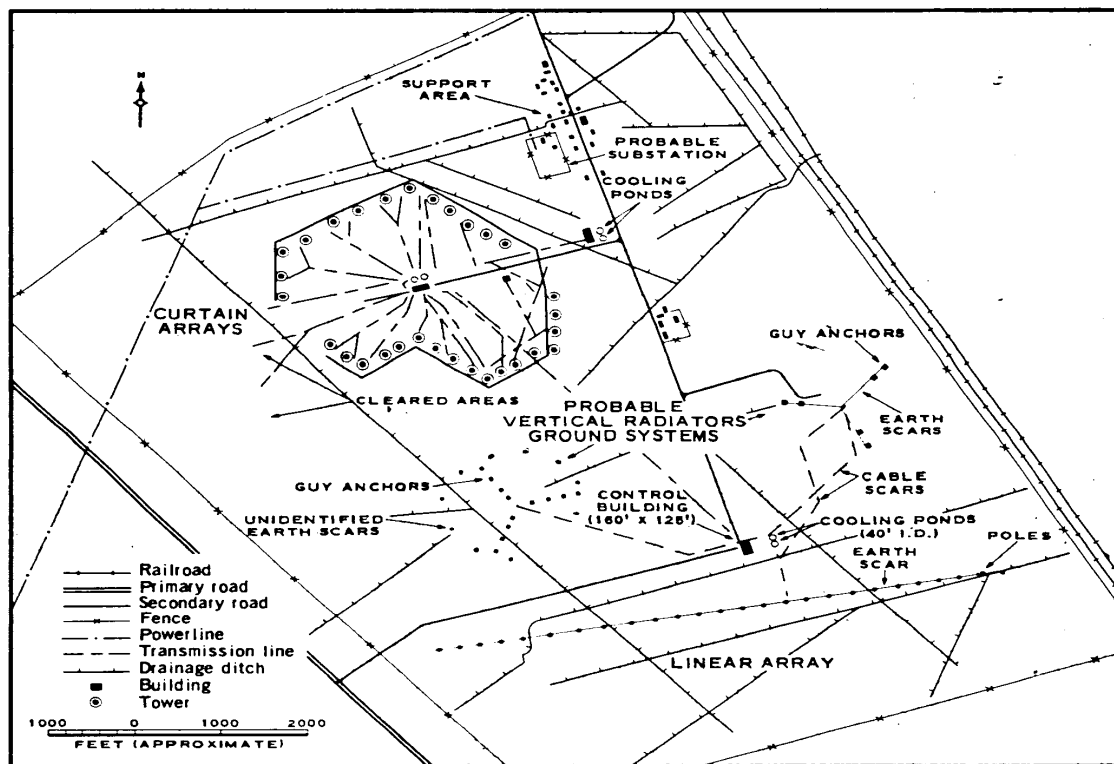


FIGURE 7. ULYANOVKA ANTENNA FARM.

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wave length, which at 620 kc would be about 750 feet, physical height (the physical height is somewhat less than the electrical height). Although the Ulyanovka ground systems are still under construction, the guy legs can be identified on one and appear identical to those at Lapichi, indicating a similar capability for the two systems.

Table 1 presents a summary of the known physical data for the four linear arrays and the data derived from these. Because of the limi-

tation in determining the exact pole height and hence the exact frequency, all frequencies have been rounded off to the nearest 1/2-mc. It was assumed that the vertical dipoles consist of two 1/4-wave elements, and standard frequency formulas were used in the computations.

Figure 8 shows probable end-firing azimuths of linear arrays as well as the pattern for broadside firing, although there is no evidence that the arrays have been modified to form broadside beams.

Table 1. Data on Linear Arrays

Physical Data			Derived Data	
LAPICHI				
25X1D	No of elements	26	Frequency	14.5 mc
	Array length	6,775 ft	Element spacing	4 wavelengths
	Element spacing		Total length	100 wavelengths
	Pole height	35 ft		
RAZDOLNOYE				
25-element Array				
25X1D	No of elements	25	Frequency	7.0 mc
	Array length	6,545 ft	Element spacing	2 wavelengths
	Element spacing		Total length	47.14 wavelengths
	Pole height	70 ft		
15-element Array				
	No of elements	15	Frequency	7.5 mc
	Array length	3,570 ft	Element spacing	2 wavelengths
	Element spacing	255 ft	Total length	28 wavelengths
	Pole height	70 ft		
ULYANOVKA				
25X1D	No of elements	26	Frequency	3.5 mc
	Array length	6,750 ft	Element spacing	one wavelength
	Element spacing		Total length	25 wavelengths
	Pole height	135 ft		

\*Except that the southwest end pole is 160 feet from the adjacent pole.

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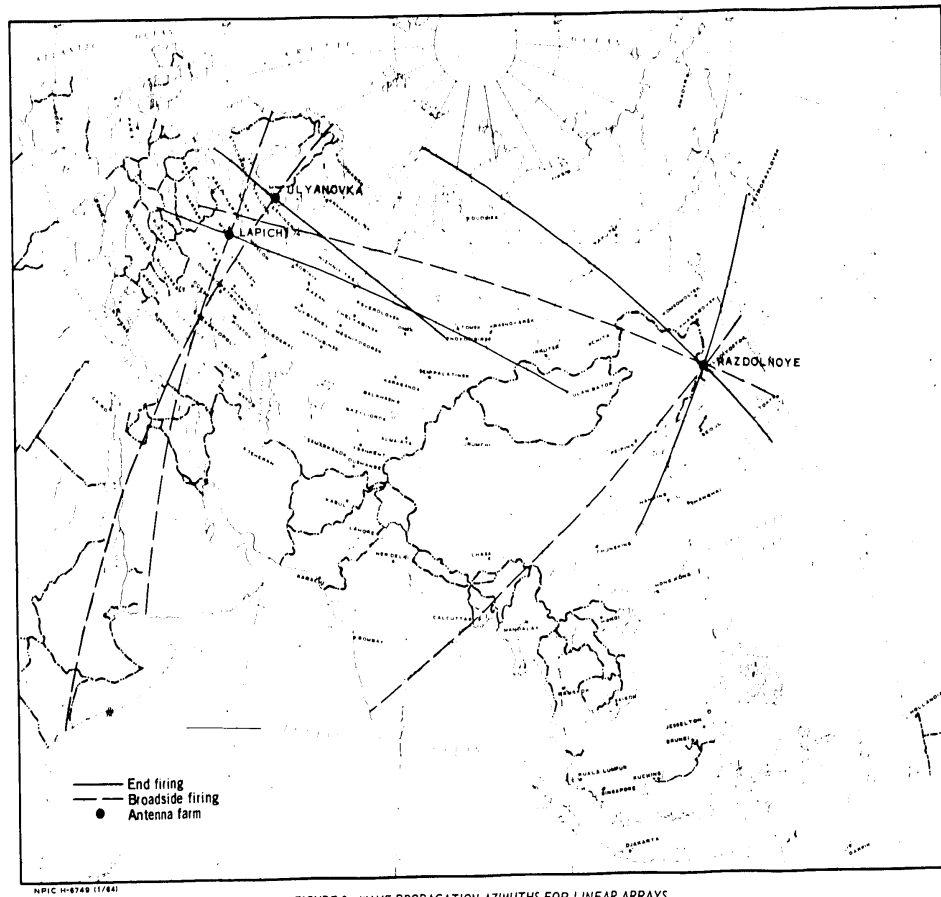


FIGURE 8. WAVE PROPAGATION AZIMUTHS FOR LINEAR ARRAYS.

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APPENDIX  
LINEAR ARRAY DEVELOPMENT

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The Soviet need for high-frequency steerable broadcasting systems has led them to experiment with a variety of antenna arrays. Such arrays are necessarily huge and therefore easily detected. Numerous large Krug-type circular arrays, steerable in azimuth for direction finding, have been built in the USSR; and various other systems including curtain arrays and fish-bone antennas are operational.

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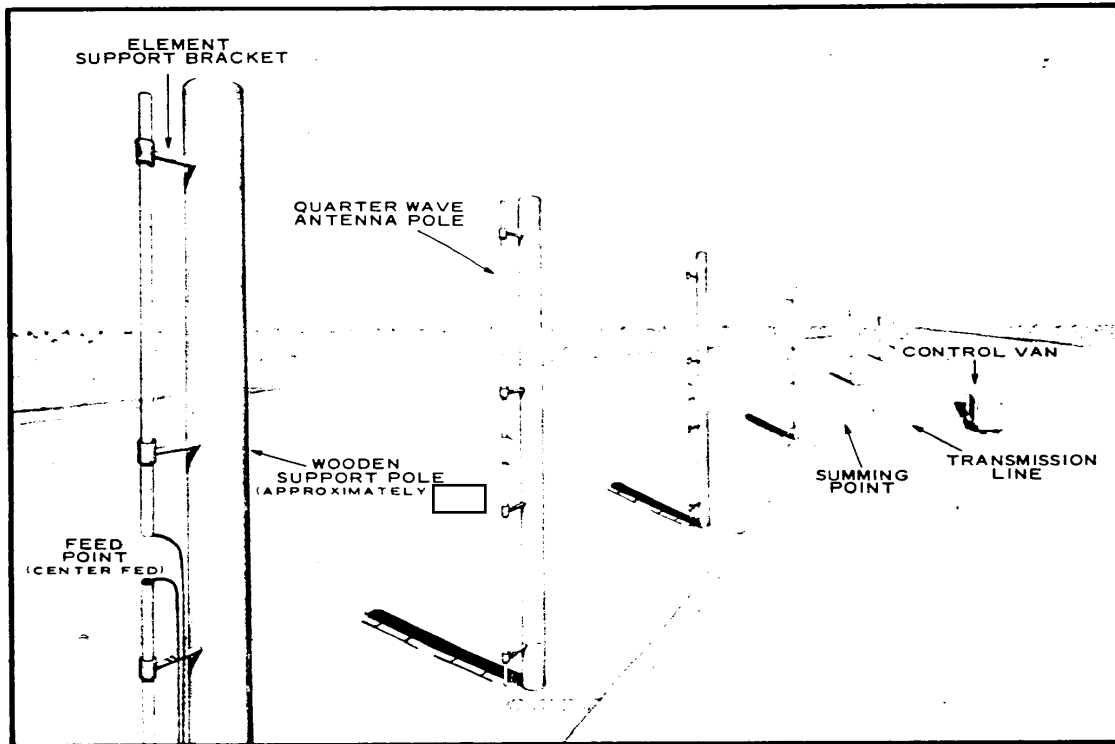


FIGURE 9. ISCAN LINEAR ARRAY.

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REQUIREMENT

DIA. AP-1-63-67

NPIC PROJECT

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